2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Van Allen Probes observations of wave and particle dynamics in the ring current of the Earth's magnetosphere

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The identification and quantification of ring current particle sources and losses is an essential aspect of understanding plasma processes in Earth's magnetosphere. Protons, helium ions, and oxygen ions are known to contribute to the ring current species population and energy density content. Ring current particles also cause equatorial-region depressions in Earth's magnetic fields during geomagnetic disturbances. These ion species play important roles in energy transport and charge exchange processes in the inner magnetosphere. The twin spacecraft NASA Van Allen Probes mission was launched (August 2012) to investigate waves and particles in Earth's radiation belts and ring current plasma on unprecedented spatial and temporal scales. We report on the comprehensive ion flux measurements of the ring current population made by the Radiation Belt Storm Probe Ion Composition Experiment (RBSPICE) instruments on each of the Van Allen Probes spacecraft. Proton (~45-keV to ~518-keV), He ion (~65-keV to ~520-keV), and O ion (~140-keV to ~1130-keV) integral and differential flux measurements, showing particle loss, injection, decay, and high-beta (β > 1) plasma events during quiet and active geomagnetic times [Gerrard et al. 2014a, 2014b, Soto-Chavez et al. 2016, Cohen et al. 2017, Lanzerotti and Gerrard, 2017]. Wave observations accompanying these particle events are also reported using magnetic field data from the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) instrument on the two spacecraft. Presented in this study are ULF wave occurrences showing anti-correlated relationship with ring current particles [Kim et al. 2017] and electromagnetic ion cyclotron (EMIC) waves associated with ion injection events during substorms. Another study shows for the first time the growth rate of the drift mirror instability in space plasmas [Soto-Chavez et al. 2018]. The new data and theoretical analyses indicate that ring current particles play a highly significant role in controlling plasma wave characteristics and vice versa.

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